

What is Claimed Is:

1 1. A vessel having a highly efficient heat exchanger, the vessel comprising:

2 A. a chamber having enclosed sides, a thermally conductive bottom end and a top
3 end forming an opening for the introduction and extraction of contents to be
4 heated, the bottom end having an external bottom side for receiving heat;

5 B. a heater comprising:

6 1. a heat source having a heat outlet disposed at a fixed distance from the
7 external bottom side and having a fuel intake port configured to couple to
8 a fuel source, the heat outlet configured to deliver heat to a central area of
9 the external bottom side;

10 2. a series of thermally conductive protrusions coupled circumferentially
11 about the central area of the external bottom side, the protrusions
12 extending from the external bottom side to a distance about equal to or
13 greater than the fixed distance;

14 3. a top housing having a top rim coupled circumferentially to the external
15 bottom side and encasing the protrusions, the housing having a series of
16 exhaust vents formed therein and having a bottom rim;

17 4. a bottom housing configured to couple to the bottom rim and substantially
18 encasing the heat source, the bottom housing having a set of air inlet vents
19 formed therein, wherein a gas flow path is formed from the air inlet vents
20 to the exhaust vents via the heat outlet.

1 2. The vessel of claim 1, further comprising a cover configured to close the opening.

1 3. The vessel of claim 1, further comprising a thermal insulator configured to substantially
2 encase the sides.

1 4. The vessel of claim 1, wherein the bottom housing and heat source are removable from
2 the top housing and the thermal insulator includes a bottom cover configured to encase the top

3 housing and protrusions.

1 5. The vessel of claim 1 wherein the heat outlet is a burner.

1 6. The vessel of claim 5, wherein the burner is configured to burn a combustible fuel,
2 including one or more of butane, propane, kerosene, gas, alcohol, or white gas.

1 7. The vessel of claim 1, wherein the protrusions take the form of a series of fins formed
2 from a single piece of thermally conductive material.

1 8. The vessel of claim 1, wherein the protrusions take the form of a series of pins.

1 9. The vessel of claim 1, wherein the chamber is a double walled chamber having an inner
2 vessel and an outer shell, the inner vessel configured to hold the contents.

1 10. The vessel of claim 9, wherein the protrusions are coupled to an exterior bottom portion
2 of the inner vessel.

1 11. The vessel of claim 1, wherein the top housing and bottom housing are integral into a
2 single unit.

1 12. The vessel of claim 1, wherein the heat outlet includes a top end configured to emit the
2 heat and an bottom end coupled to the fuel source, the heater further comprising:

3 5. a baffle plate disposed at the bottom end of the heat outlet, the baffle plate
4 having one or more air vents formed therein configured to deliver a
5 predetermined amount of air received from the air inlet vents to the heat
6 outlet, as part of the gas flow path.

1 13. A high efficiency heater comprises:

2 A. a heat source having a heat outlet disposed at a fixed distance from a surface to be

3 heated and having a fuel intake port configured to couple to a fuel source, the heat
4 outlet configured to deliver heat to a central area of the surface;

5 B. a series of thermally conductive protrusions coupled circumferentially about the
6 central area of the surface, the protrusions extending from the surface to a
7 distance about equal to or greater than the fixed distance;

8 C. a skirt having a top rim coupled circumferentially to the surface and encasing the
9 protrusions, the skirt having a series of exhaust vents formed therein and having a
10 bottom rim;

11 D. a base configured to couple to the bottom rim and substantially encasing the heat
12 source, the base having a set of air inlet vents formed therein, wherein a gas flow
13 path is formed from the air inlet vents to the exhaust vents via the heat outlet; and

14 E. a baffle plate disposed below the heat outlet and above the air inlet vents, the
15 baffle plate having one or more air vents formed therein configured to deliver a
16 predetermined amount of air received from the air inlet vents to the heat outlet, as
17 part of the gas flow path.

1 14. A heating vessel for use with a heater for heating a liquid comestible, the heater having a
2 fuel supply system, an upper support structure, and a burner head bounded by a peripheral
3 border, the heating vessel comprising:

4 A. an inner vessel for holding the liquid comestible to be heated, said inner vessel
5 having an inner vessel interior surface, an inner vessel exterior surface, and an
6 open top, said inner vessel extending downward from said open top to terminate
7 in an inner vessel bottom;

8 B. a housing having a housing sidewall with a housing sidewall exterior surface and
9 a housing sidewall interior surface, said housing sidewall terminating in a housing
10 sidewall base region and a housing sidewall top region, said housing sidewall
11 being configured such that said inner vessel, when positioned and affixed in said
12 housing, provides an annular gap between said inner vessel exterior surface and
13 said housing sidewall interior surface, said housing sidewall top region having
14 exhaust vents therethrough communicating with said annular gap;

15 C. means associated with said sidewall base region for mounting said housing to the
16 upper support structure of the heater, said means for mounting said housing being
17 configured to position the burner head under said inner vessel bottom; and
18 D. downwardly-directed protrusions provided on said inner vessel exterior surface,
19 said protrusions extending beyond said inner vessel bottom and positioned such
20 that said protrusions are arranged around the peripheral border of the burner head
21 so as to provide a cavity, the projection of which encompasses the burner head so
22 as to collect a substantial portion of the heat from the combustion gasses produced
23 by the burner head as the hot combustion gasses pass through said arrangement of
24 said downwardly-directed protrusions into said annular gap.

1 15. The heating vessel of claim 14 wherein said protrusions have an aspect ratio of at least
2 about 5.

1 16. The heating vessel of claim 15 wherein said protrusions have an aspect ratio between
2 about 10 and 20.

1 17. The heating vessel of claim 15 wherein said protrusions are substantially oriented to
2 minimize radial obstruction of the flow of the combustion gasses from the burner head.

1 18. The heating vessel of claim 15 wherein said protrusions are arranged in at least one ring
2 disposed about the burner head.

1 19. The heating vessel of claim 14 wherein said protrusions are attached to said inner vessel
2 bottom.

1 20. The heating vessel of claim 14 wherein said protrusions are formed by undulations in at
2 least one protrusion piece.

1 21. The heating vessel of claim 14 wherein said protrusions are connected by connecting

2 segments, a portion of which are attached to said inner vessel bottom.

1 22. The heating vessel of claim 21 wherein said protrusions have an aspect ration of at least
2 about 8.

1 23. The heating vessel of claim 14 wherein some of said protrusions radially extend beyond
2 said inner vessel bottom and transverse a portion of said inner vessel exterior surface..

1 24. The heating vessel of claim 14 wherein the separation of said open top from said inner
2 vessel bottom defines an inner vessel height H and said portion of the inner vessel exterior
3 surface traversed by said protrusions is less than about $1/4$ of said inner vessel height H .

1 25. The heating vessel of claim 14 further comprising an insulating layer attached to said
2 housing sidewall interior surface and configured to allow said exhaust vents to communicate
3 with said gap.

1 26. The heating vessel of claim 14 further comprising a baffle plate having a plate central
2 passage sufficient to accommodate the burner head and configured to engage said housing
3 sidewall.

1 27. The heating vessel of claim 14 further comprising:

2 E. a handle for attachment to said housing; and

3 F. means for removably attaching said handle to said housing,

4 G. said handle being configured to be stored inside said inner vessel when removed
5 from said housing.

1 28. The heating vessel of claim 14 wherein the heater is dedicated to use with the heating
2 vessel and said means for mounting said housing to the upper support structure of the heater are
3 provided by affixing the upper support structure to said housing sidewall base region of said
4 housing.

1 29. The heating vessel of claim 14 further comprising intake ports in said housing sidewall
2 base region.

1 30. The heating vessel of claim 14 wherein the upper support structure of the heater is made
2 integral with said housing sidewall base region of said housing.

1 31. The heating vessel of claim 14 further comprising:

2 E. a burner mounting coupling formed on the upper support structure of the heater;
3 and,

4 F. a housing mounting coupling on said sidewall base region, said housing mounting
5 coupling being configured to fixably mate with said burner mounting coupling of
6 the heater.

1 32. The heating vessel of claim 14 wherein the upper support structure of the heater is
2 provided by a plurality of support members designed to support a conventional cooking vessel,
3 said means for mounting said housing to the upper support structure further comprises:

4 E. a plurality of recesses in said sidewall base region, said recesses each being
5 positioned and configured to engage one of the plurality of support members of
6 the heater so as to support said housing sidewall thereon.

1 33. The heating vessel of claim 31 wherein said plurality of recesses in said sidewall base
2 region includes a first series of recesses positioned at 90° angles and a second series of
3 recesses positioned at 120° angles.

1 34. The heating vessel of claim 14 further comprising:

2 E. a blocking ring which slidably, rotatably engages said housing sidewall base
3 region, said blocking ring having a first series of cutouts which can be aligned
4 with said first series of recesses and a second series of cutouts which can be
5 aligned with said second series of recesses.

1 35. The heating vessel of claim 14 wherein said housing further comprises:
2 1. an exterior wall member, on which at least a portion of said housing
3 sidewall exterior surface is provided;
4 2. an interior wall member, on which at least a portion of said housing
5 sidewall interior surface is provided, said interior wall member being
6 spaced apart from said exterior wall member to form an annular passage
7 therebetween, said annular passage communicating with said exhaust
8 vents; and
9 3. means for allowing ingress of air into said annular passage at said housing
10 sidewall base region.

1 36. The heating vessel of claim 35 wherein said housing further comprises:
2 4. an upper notched ring in said housing sidewall top region to which said
3 exterior wall member and said interior wall member are mounted, said
4 upper notched ring having spaces therein which allow said annular
5 passage to communicate with said exhaust vents.

1 37. The heating vessel of claim 36 wherein said housing further comprises:
2 5. a lower notched ring in said housing sidewall base region to which said
3 exterior wall member and said interior wall member are mounted, said
4 lower notched ring having spaces therein which provide said means for
5 allowing ingress of air into said annular passage at said housing sidewall
6 base region; and
7 6. a baffle plate affixed to said interior wall member at said housing sidewall
8 base region, said baffle plate residing below said protrusions and having a
9 plate central opening therein which is sized larger than the peripheral
10 border of the burner head.

1 38. A self-heating vessel which combines a heating vessel for holding liquids and a gas

2 burner for heating the vessel and the liquid contained therein, the self-heating vessel comprising:

- 3 A. an inner vessel designed to hold the liquid to be heated, said inner vessel having
4 an inner vessel interior surface and an inner vessel exterior surface, said inner
5 vessel having an open top and extending downward from said open top to
6 terminate in an inner vessel bottom;
- 7 B. a housing having a housing sidewall with a housing sidewall exterior surface and
8 a housing sidewall interior surface, said housing sidewall terminating in a housing
9 sidewall base region and a housing sidewall top region, said housing sidewall
10 being configured such that said inner vessel, when positioned and affixed in said
11 housing, provides an annular gap between said inner vessel exterior surface and
12 said housing sidewall interior surface, said housing sidewall top region having
13 exhaust vents therethrough communicating with said annular gap;
- 14 C. a gas heater having a fuel supply system and a burner head bounded by a
15 peripheral border, said gas heater being mounted to said housing sidewall base
16 region of said housing so as to position said burner head under said inner vessel
17 bottom; and
- 18 D. downwardly-directed protrusions provided on said inner vessel exterior surface,
19 said protrusions extending beyond said inner vessel bottom and positioned such
20 that said protrusions are arranged around said peripheral border of said burner
21 head so as to provide a cavity, the projection of which encompasses said burner
22 head so as to collect a substantial portion of the heat from the combustion gasses
23 produced by said burner head as the combustion gasses pass through said
24 arrangement of said downwardly-directed protrusions into said annular gap.

1 39. The heating vessel of claim 38 wherein said fuel supply system further comprises:

- 2 1. a fuel tank; and
- 3 2. a fuel and air mixing tube which is positioned between said burner head
4 and said fuel tank, said fuel and air mixing tube having a substantial
5 portion of its path being parallel to said inner vessel bottom.

1 40. The heating vessel of claim 38 wherein of said gas heater is made integral with said
2 housing sidewall base region of said housing.

1 41. The heating vessel of claim 38 further comprising:

2 E. a burner mounting coupling formed on said gas heater; and,

3 F. a housing mounting coupling on said sidewall base region, said housing mounting
4 coupling being configured to attachably mate with said burner mounting coupling
5 of said gas heater.